National Aeronautics and Space Administration

MARSHALL STAR

Serving the Marshall Space Flight Center Community

Aug. 20, 2009

Space shuttle Discovery scheduled to launch Aug. 25 from Kennedy Center

By Sanda Martel

Space shuttle Discovery is scheduled to launch Aug. 25 from the Kennedy Space Center, Fla., NASA managers announced Aug. 19 at the conclusion of an agency-level flight readiness review. Launch time is 12:36 a.m. CDT.

The Aug. 18 review ran over until Aug. 19 because of lengthy discussions about external tank foam losses during the two most recent space shuttle missions, STS-127 in July and STS-125 in May. Engineers discussed data from recent testing on Discovery's external tank, ET-132, and decided that it is ready to launch on the STS-128 mission to the International Space Station.

The main areas of discussion in the review included foam losses on the bipod and ice frost ramps on the liquid oxygen tank and the intertank. Detailed analyses of all three foam loss areas relative to STS-128 and ET-132 were complete and ET-132 was judged ready to launch.

Intertank and ice frost ramp foam losses on the two previous missions caused engineers to test foam samples on Discovery's external tank. Some 144 intertank foam samples were

*See **STS-128** on page 8*

Ares I-X team completes assembly of test rocket; flight test is targeted for Oct. 31

For the first time in more than a quarter-century, a new space vehicle stands ready in NASA Kennedy Space Center's Vehicle Assembly Building in Florida.

The final segments of the Ares I-X rocket, including the simulated crew module and launch abort system, were stacked Aug. 13 on a mobile launch platform, completing the 327-foot launch vehicle and providing the first

*See **Stacking** on page 7*

Bolden, Garver visit Marshall

Emmett Given/MSFC

NASA Administrator Charles Bolden speaks at his first all-hands at the Marshall Space Flight Center, as Deputy Administrator Lori Garver looks on. Bolden and Garver visited the Marshall Center Aug. 19.

INSIDE

Chandra's 10th anniversary

Special 4-page insert begins on page 3

Marshall Center contract firm, Engineering Directorate team earn technology awards

By Alexandria Randolph

The Marshall Space Flight Center has presented a pair of technology achievement awards for work benefiting its spaceflight mission.

The 2009 "Software of the Year" award was presented to three employees of AI Signal Research Inc. of Huntsville, or ASRI: Dr. Jen-Yi Jong, chairman and director of research and development; Thein A. Maung, senior analyst; and Jess H. Jones, senior staff engineer. The "Invention of the Year" award for 2009 was given to NASA engineers Richard Howard, Michael Book and Thomas Bryan, all of Marshall's Engineering Directorate.

ASRI's award-winning software, a dynamic signal analysis technique called PC-SIGNAL® Pseudo Key Phasor, or PKP, was developed in cooperation with the Marshall Center's Engineering Directorate. The analysis technique was developed by Jong; Maung served as programmer and Jones led testing and evaluation of the software. They have been developing the PC-Signal family of software since ASRI was founded in 1990.

PKP is one of several diagnostic tools in the company's PC-Signal software package, which is being used in space shuttle vibration and acoustical analysis and in the design of NASA's Ares I rocket -- the next-generation launch vehicle that will carry explorers to the moon and beyond in coming years.

Typically, Jong said, vibration signal analysis relies on intrusive sensor installation to gather engine speed data. To analyze more sensitive systems, such as the space shuttle main engine, PKP's signal processing technique offers a simpler solution. "It allows reconstruction of precise speed information directly from external vibration measurements, thereby enabling all other analyses techniques that require speed data," Jong said.

The software is used to perform dynamic data analysis and diagnostic evaluation of the shuttle main engines, and to review and analyze engine health data from shuttle missions. It also is used to process and analyze data during rocket development and testing, enabling engineers to more quickly and easily identify potential design issues related to vibration and oscillation.

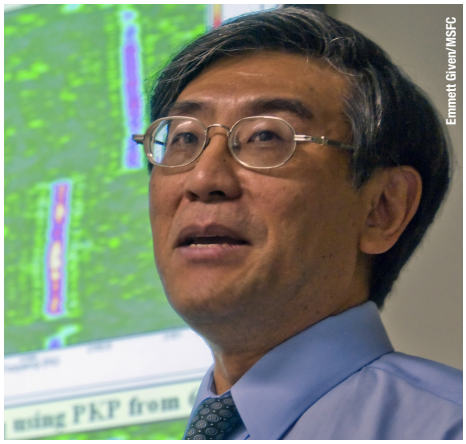
As the Marshall Center's software winner for 2009, ASRI will represent Marshall in competition with all other NASA centers for the agency's "Software of the Year" Award, which will be awarded in early 2010.

The Marshall's Center's 2009 "Invention of the Year" award was presented to Howard, Book and Bryan, all members of the center's Advanced Vehicle Sensors team, for their development of the "Control Method for Video Guidance Sensor System."

The technology is a new refinement to a system that uses lasers and long-distance light reflection to provide precise readings of distance, angle of approach and alignment for two moving objects in space.

The work is critical to NASA's development of an automated rendezvous and docking system, used to remotely link two orbiting vehicles or satellites in space for transfer of fuel, cargo or other activities -- without direct human contact.

The system works much like a camera and bicycle reflectors. Lasers installed on one orbiting vehicle project light toward reflectors mounted on the second vehicle. The reflectors bounce the light back to the primary craft. The new, award-winning control system captures the image and immediately analyzes the distance, direction, yaw, pitch and roll of the approaching spacecraft.

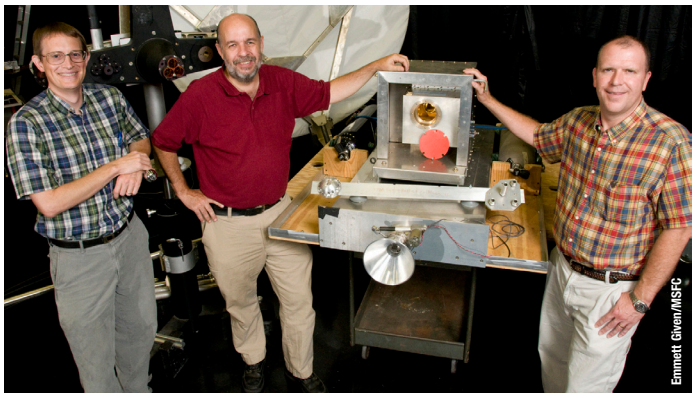


Dr. Jen-Yi Jong of AI Signal Research Inc. of Huntsville, developer of the Marshall Center's 2009 Software of the Year.

NASA engineers began developing the advanced sensor system in 1987. The technology since has been tested on the ground and during two space shuttle flights: the Demonstration of Autonomous Rendezvous Technology, or DART, mission in 2005; and Orbital Express, a joint 2007 mission with the Defense Advanced Research Projects Agency.

NASA hopes the technology may serve NASA's next-generation launch vehicles and future missions to the International Space Station and beyond -- including the Orion crew capsule, intended to carry future explorers to space, and the Altair lunar lander, the transport vehicle that will ferry them to the surface of the moon.

Randolph recently completed a summer internship supporting the Marshall Center's Public & Employee Communications Office.



Marshall engineers and "Invention of the Year" award winners, from left, Ricky Howard, Thomas Bryan and Michael Book with the video guidance sensor system for which they developed new control technology.

10 years of Chandra

Exploring the invisible universe

Marshall-managed program

How Chandra changed what we saw

By Mike Wright

In July 1999, NASA launched the Chandra X-ray Telescope, the world's most powerful X-ray telescope – packed with the strength and accuracy to read a newspaper from a half-mile away or see the letters of a stop sign from 12 miles.

A month later, Chandra released its spectacular first celestial images. Unlike other telescopes, Chandra was designed to study X-rays rather than visible light or gamma rays. Since X-rays are absorbed by the Earth's atmosphere, space-based observatories are necessary to study these phenomena. By capturing images created by these invisible rays, the observatory has allowed scientists to analyze some of the greatest mysteries of the universe.

The journey from the Chandra program inception to the initial image was a challenging one. The Marshall Space Flight Center managed the program. Marshall focused on precision engineering and attention to detail. "It has been a long, hard road," said Marshall's Fred Wojtalik following the launch in 1999. Wojtalik served as manager of the Chandra X-ray Observatory Program and manager of the Observatory Projects Office at the center.

With its combination of a large mirror area, accurate alignment and efficient X-ray detectors, Chandra has 10-times greater resolution and is 50-to-100 times more sensitive than any previous X-ray telescope. Chandra's mirrors are the smoothest ever created. If the surface of the state of Colorado were as relatively smooth, Pike's Peak would be less than an inch tall. The Chandra team not only produced and polished the mirrors, but also created the systems to put them together.

The team also had to align all the components to within miniscule tolerances, assemble them into a spacecraft that could survive the rigors of launch and space, then test them and validate their performance. In many instances, the Chandra team had to come up with new processes for things that had never been done before. The team developed, built and validated a measurement system that was used to make sure the cylindrical mirrors were ground correctly and polished to the right shape.

The eight mirrors are the largest of their kind – the biggest is 4 feet in diameter and 3 feet long. The mirror group weighs more than a ton. The team created and executed a system to carefully assemble the mirrors into a total package that could survive the rigors of a rocket ride, weightlessness and the temperature extremes of space.

The spacecraft is made of graphite epoxy to meet stringent weight requirements, and yet Chandra is the largest and heaviest payload ever deployed from the space shuttle. Fully fueled, Chandra weighed 12,930 pounds. With the inertial upper stage set of boosters added to the craft, the assembly totaled 50,162 pounds and measured 45.3 feet long by 64 feet wide with its solar arrays deployed.

On the other end of the size spectrum, microtechnology was used in manufacturing processes to make components for Chandra's imaging systems. Spectrographic transmission gratings, used to precisely determine the energies of incoming X-rays, had never been built before. The gratings include tiny gold bars that are closer together than a wavelength of visible light. It would take hundreds of the bars to equal the thickness of a sheet of paper. Plastic membranes, thin as a soap bubble, support the bars. While all of these incredible items were being designed and built, the team also had to make sure that they all came together to form the very best overall system.

The spacecraft had to be precise and reliable. Also, the ground control system and its operating staff had to be able to efficiently and safely operate Chandra for years to come. The team tested and retested the spacecraft and ground system together to make sure they were compatible. For the optics system testing, they made sure that they had at least two ways to crosscheck all results. In some instances, the team had multiple checks.

Calibrating and validating the telescope's scientific operation proved to be another challenge. Unlike optical astronomy, where there are established, well-known targets in the universe that can be used for calibration purposes, there are not any for X-ray images.

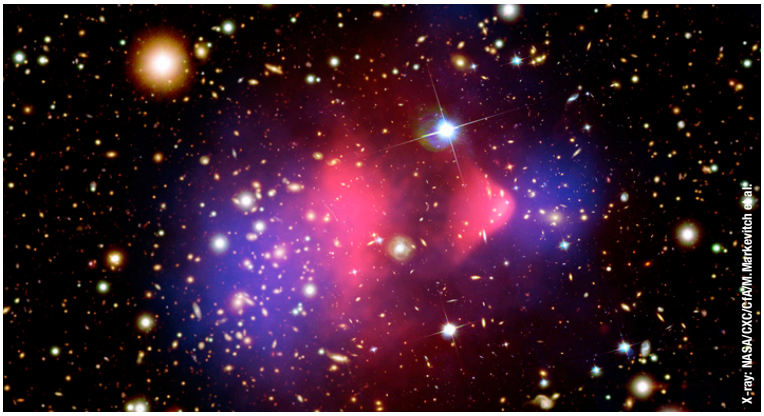
A new, world-class X-Ray Calibration Facility was built at the Marshall Center to precisely calibrate Chandra's X-ray optics. The facility also provided opportunities for additional crosschecks of the total optical system and for an independent check of Chandra's optical performance. From X-rays entering the optics to the quality of the images produced by the science instruments, the testing verified the exceptional accuracy of Chandra's optics. Chandra is so finely tuned that it can detect objects separated by a half-arc second. That is like identifying two dimes side-by-side from two miles away.

*See **Chandra** on page 5*

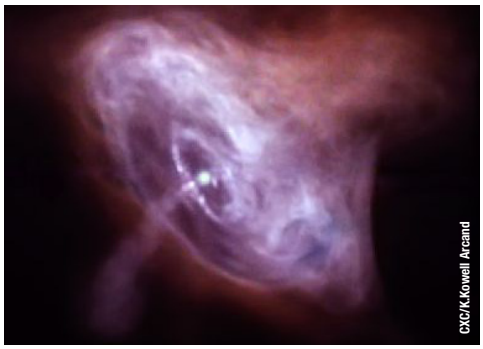
CHANDRA'S 10TH ANNIVERSARY

Doug Swartz, a senior scientist with Universities Space Research Association of Columbia, Md., supporting the Marshall Space Flight Center's Science & Mission Systems Office, chose this photo as his favorite Chandra image. "The nearby galaxy M82 is shaped sort of like a pancake," Swartz said. "It is viewed nearly edge-on in this picture and is the bright portion that extends in a line from the lower left to the upper right. This galaxy is the 'Superwind' of X-ray-emitting hot gas, seen perpendicular to the plane of the galaxy, that is throwing star-stuff out into the intergalactic medium. This Superwind is energized by hundreds of exploding stars."

A small, dense object only 12 miles in diameter is responsible for this beautiful X-ray nebula that spans 150 light years. At the center of this image, made by NASA's Chandra X-ray Observatory, is a very young and powerful pulsar. The pulsar is a rapidly spinning neutron star which is spewing energy out into the space around it to create complex and intriguing structures, including one that resembles a large cosmic hand.

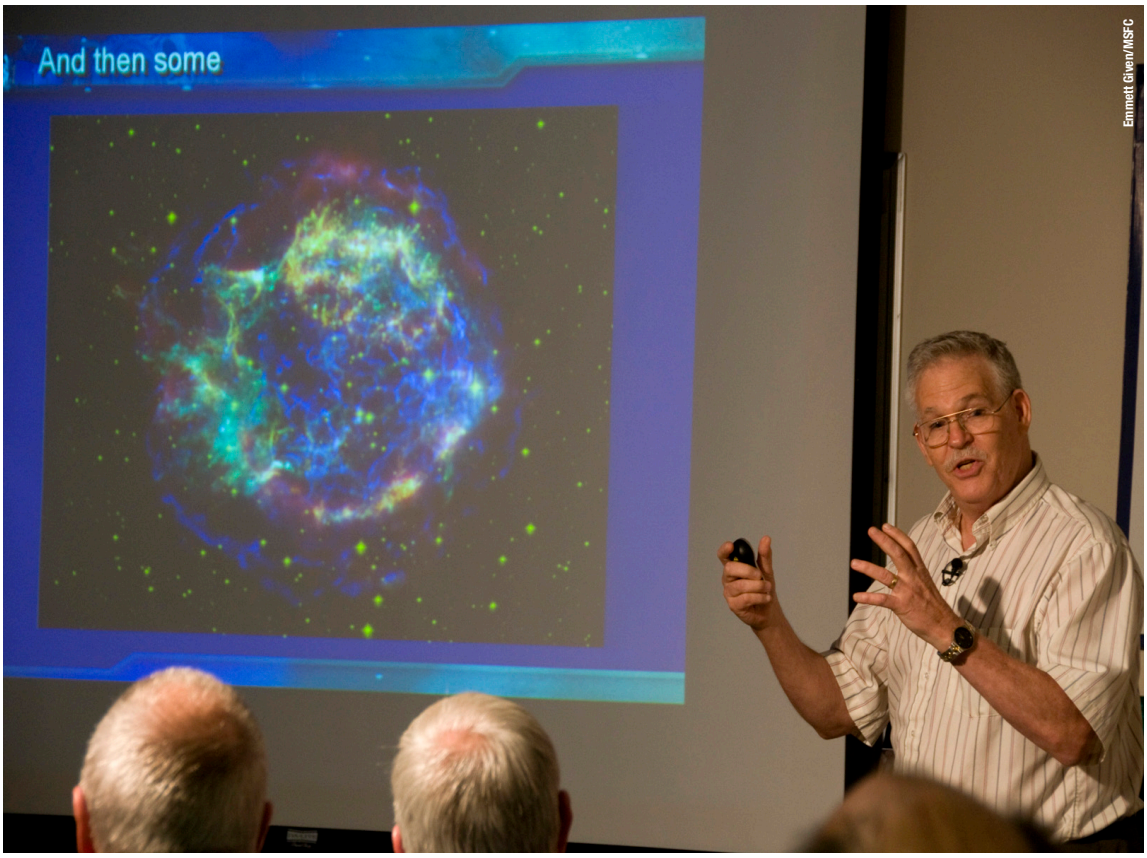


Composite image of a Bullet Cluster, where the collision of two large clusters of galaxies is occurring.



Chandra image of the Crab synchrotron nebula and pulsar.

CHANDRA'S 10TH ANNIVERSARY



Emmett Given/MSFC

Martin Weisskopf, project scientist for NASA's Chandra X-ray Observatory, presents an overview of 10 years of Chandra science Aug. 12 at the National Space Science & Technology Center in Huntsville. Key Chandra project leaders and researchers at the Marshall Space Flight Center met to discuss the observatory's science accomplishments and program status. Chandra enables scientists from around the world to obtain unprecedented X-ray images of exotic environments to help understand the evolution of the cosmos.

Chandra *Continued from page 3*

NASA launched Chandra on July 23, 1999, at 11:31 p.m. CDT, from the Kennedy Space Center, Fla., as the primary payload on space shuttle mission STS-93. Its onboard computers had activated flawlessly prior to launch at 2:25 a.m.

On Aug. 4, 1999, at 11:36 a.m., controllers at the Chandra Operations Control Center in Cambridge, Mass., commanded the observatory's engines to ignite. The Northrop Grumman-built Chandra used five engine firings of its integral propulsion system to propel itself from a temporary transfer orbit, where it was placed by an inertial upper stage to a highly elliptical Earth orbit that extends more than one-third the distance to the moon.

On Aug. 8, 1999, following a pre-planned series of commands from the flight operations team, Chandra's Advanced Charge-Coupled Device Imaging Spectrometer door opened, clearing the way for additional activation and testing of the instrument used to take Chandra's first images. Meanwhile, controllers continued activation and checkout of the observatory's science instruments and began the process of replacing the early mission flight software in Chandra's onboard computers with software for the operational phase of the mission.

Wojtalik expressed pride in the observatory team at the time. "A great number of people from NASA and industry, here and around the country, have put in a tremendous effort to get where we are."

Jean R. Olivier, who served as Marshall's deputy manager of the program, said the most significant progress related to the Chandra mission came with the "first firing of the integral propulsion system." He said the spacecraft system "worked even better than expected."

Marshall's Dr. Martin C. Weisskopf, who served as project scientist for Chandra, expressed his excitement over the scientific discoveries expected from the observatory. Responsible for the scientific integrity of the program, Weisskopf spent 22 years of his life helping to make Chandra possible – "breathing it."

When joining the project in 1977, he took out a piece of paper and wrote his estimate of when the telescope would launch: the year 2000.

"I did not expect it to go fast," he said. "We've actually exceeded my expectations." After committing his prediction to paper, Weisskopf saw his children grow up, watched them have children and held on to that piece of paper.

Wright is the Marshall Center historian.

Ten of Chandra's Scientific Contributions

NASA's Chandra X-ray Observatory is celebrating 10 years of exploring the invisible universe. On Aug. 19, 1999, Chandra captured its first image as an astronomical observatory. This first light image opened a new era for science as Chandra began its mission to open a mysterious universe.

Chandra enables scientists from around the world to obtain unprecedented X-ray images of exotic environments to help understand the evolution of the cosmos. The observatory not only helps to probe these mysteries, but also serves as a unique tool to study detailed physics in a laboratory that cannot be replicated on Earth.

"Chandra has changed the whole understanding of dark matter and increased our knowledge of dark energy, as well as gathered new information on black holes," said Dr. Martin Weisskopf, Chandra project scientist at the Marshall Space Flight Center.

"Chandra has produced 10,000 observations in its 10-year life and the demand for observation time, by scientists, is five- to six-times what is available," said Chandra Program Manager Keith Hefner of the Marshall Center. "It continues to be an engineering marvel that has more than doubled its original five-year mission."

A Chandra Top 10 reveals some of the most noteworthy discoveries:

1. Chandra finds a ring around the Crab Nebula. After only two months in space, the observatory reveals a brilliant ring around the heart of the Crab Pulsar in the Crab Nebula – the remains of a stellar explosion -- providing clues about how the nebula is energized by a pulsing neutron, or collapsed star. (Sept. 28, 1999)

2. Chandra finds the most distant X-ray cluster. Using the Chandra Observatory, astronomers find the most distant X-ray cluster of galaxies yet. Approximately 10 billion light years from Earth, the cluster 3C294 is 40 percent farther than the next most distant X-ray galaxy cluster. (Feb. 15, 2001)

3. Chandra makes deepest X-ray exposure. A Chandra image, Deep Field North, captures for 23 days an area of the sky one-fifth the size of the full moon. Even though the faintest sources detected produced only one X-ray photon every four days, Chandra finds more than 600 X-ray sources, most of them super massive black holes in galaxy centers. (June 19, 2003)

4. Chandra hears a black hole. Using the Chandra observatory, astronomers for the first time detected sound waves from a super massive black hole. Coming from a black hole 250 million light years from Earth, the "note" is the deepest ever detected from an object in the universe. (Sept. 9, 2003)

5. Chandra opens a new line of investigation on dark energy. Using galaxy-cluster images from Chandra, astronomers apply a powerful, new method for detecting and probing dark energy. The results offer intriguing clues about the nature of dark energy and the fate of the universe. (May 18, 2004)

6. Chandra finds that Saturn reflects X-rays from the sun. The findings stem from the first observation of an X-ray flare reflected from Saturn's low-latitudes -- the region that correlates to Earth's equator and tropics. (May 25, 2005)

7. Chandra finds proof of dark matter. In galaxy clusters, the normal matter, like the atoms that make up the stars, planets, and everything on Earth, is primarily in the form of hot gas and stars. The mass of the hot gas between the galaxies is far greater than the mass of the stars in all of the galaxies. This normal matter is bound in the cluster by the gravity of an even greater mass of dark matter. Without dark matter, which is invisible and can only be detected through its gravity, the fast-moving galaxies and the hot gas would quickly fly apart. (Aug. 21, 2006)

8. Chandra sees brightest supernova ever. The brightest stellar explosion ever recorded may be a long-sought new type of supernova, according to observations by NASA's Chandra X-ray Observatory and ground-based optical telescopes. This discovery indicates that violent explosions of extremely massive stars were relatively common in the early universe, and that a similar explosion may be ready to go off in our own galaxy. (May 7, 2007)

9. Chandra finds a new way to weigh black holes. By measuring a peak in the temperature of hot gas in the center of the giant elliptical galaxy NGC 4649, scientists have determined the mass of the galaxy's super massive black hole. The method, applied for the first time, gives results that are consistent with a traditional technique. (July 16, 2008)

10. Long observation from Chandra identified the source of this energy for blobs. The X-ray data show that a significant source of power within these colossal structures is from growing super massive black holes partially obscured by dense layers of dust and gas. The fireworks of star formation in galaxies are also seen to play an important role, thanks to Spitzer Space Telescope and ground-based observations. (June 24, 2009)

The Marshall Center manages the Chandra program for the Science and Mission Directorate, NASA Headquarters, Washington. Northrop Grumman of Redondo Beach, Calif., formerly TRW Inc., was the prime development contractor for the observatory. The Smithsonian Astrophysical Observatory controls science and flight operations from the Chandra X-ray Center in Cambridge, Mass.

For more information visit: www.nasa.gov\chandra

Stacking *Continued from page 1*

The fully stacked Ares I-X test rocket stands 327 feet tall in High Bay 3 of the Kennedy Center's Vehicle Assembly Building in Florida.

complete look of Ares I-X's distinctive shape. The Ares I-X flight test is targeted for Oct. 31.

"This is a special feeling," said Steve Davis, Ares I-X deputy mission manager at the Marshall Space Flight Center. "To see this enormous rocket finally assembled is wonderful. It also reminds us that we are not finished yet. We have some important testing in front of us. But the finish line is now clearly within sight."

Now that the test rocket is assembled, numerous evaluations will be run on all the systems, including the set of instruments that will measure the rocket's movements as it launches and the first stage separates. The rocket is wired throughout with more than 700 sensors to gather data during the flight in order to provide Ares engineers with an opportunity to test their predictions and refine their computer models.

The Ares I-X flight test will also provide NASA an early opportunity to test and prove hardware, facilities and ground operations associated with the Ares I crew launch vehicle. It will allow NASA to gather critical data during ascent of the integrated Orion spacecraft and the Ares I rocket. The data will ensure the entire vehicle system is safe and fully operational before astronauts begin traveling to orbit.

Classified Ads

To submit a classified ad to the Marshall Star, go to Inside Marshall, to "Employee Resources," and click on "Employee Ads — Submit Ad." Ads are limited to 15 words, including contact numbers. No sales pitches. Deadline for the next issue, Aug. 27, is 4:30 p.m. Thursday, Aug. 20.

Miscellaneous

Three-piece living room suite, wood trim; two leather rocker/recliners. 772-3800

Four tickets to the Nationwide and Sprint Cup Bristol night race. 777-8916

7-year-old Appaloosa gelding, 14.2hh, part-time lesson horse, English or Western, $1,500. 325-4111 leave message

1960s Fender Bassman Amp, $1,000; solid oak gossip bench, $100; vintage records. 679-9383

Nike Sumo 5900 driver, regular shaft, head cover, $120. 653-1568

52 mm camera UV and adjustable polarizing filters, canvas bag, $20. 325-6000

Four Eagle Racing Rims that fit a 1989 Ford F-150, $200. 520-9244

Sony Cassette Deck TC-K60, 100 cassette tapes, $30. 655-3324 leave message

16-inch sprocket-nose Poulan chainsaw bar, never installed, $5. 534-1461

Two Auburn / Mississippi State football tickets. 536-6436 leave message

2003 Ford F-150 crew cab factory bedliner, $100. 880-6335

Vehicles

2008 KX250F, all factory, title, $3,700 obo. 615-417-3157

2007 Sidney Outback 28-foot fifth wheel camper, $19,500. 679-2410

2007 Yamaha FX HO Waverunners, two, 40 hours each, $15,500 obo. 714-4040

2006 Chrysler Pacifica Touring, third row, red, 24k miles, $14,500. 797-1300

2006 V-Star 1100, 2,700 miles, $6,500. 426-7945

2004 Harley Davidson Sportster 1200C, 1,250 miles, $7,500. 656-4719

2000 Olds Silhouette, LS, gold, 98.3k miles, $5,500. 533-5443

1999 Toyota Tacoma Pre-runner, tow package, bedliner, CD, AC, 134,600 miles, $6,100. 830-6584

1994 Yamaha ATV, 350cc Moto-4, two-wheel drive, new brakes/ air filter, $1,350. 653-7016

1992 Mercedes 190E 2.3, 155k miles, $2,400; 1985 Classic Jaguar XJ6, 85K miles, $3,900. 885-2125

1986 Bronco II, 4WD, V6, $2,000 obo. 881-6143

Wanted

Responsible lady to pick up and care for daughters after school. 880-2290

Four tickets to Alabama vs. Arkansas football game, Sept. 26. 737-7246

Man's and woman's bikes, mountain or 10-speed. 468-4416

Tickets to Alabama vs. Virginia Tech and Alabama vs. Kentucky. 679-5736

16- to 18-foot car hauler /trailer, must have dual axles and brakes. 301-9026

Matching washer and dryer. 883-2757

Electrical work to do, wiring houses, garages, yard lights, adding/removing switches, plugs, lights. 468-8906

Furniture: Sectional couch, recliners, tables/lamps, beds, two queen and one king, patio, dining. 631-8915

Free

Two pure-bred Maltese puppies to good home. 508-6989

Wooden children's playset, swings, rope-climb, slide, monkey bars, small fort, needs some repair. 783-6594

Firewood, wild cherry slabs, oak logs, needs to be chainsawed, you haul. 653-7016

1970s vintage LPs, seven dozen, mostly rock 'n roll. 655-3324 leave message

Lost

Motorcycle glove, red and black, around Building 4718. 544-0643

Science & Mission Systems Office honors team at annual ceremony

The Marshall Space Flight Center's Science and Mission Systems Office paid tribute to its outstanding employees at the organization's annual awards ceremony. The event was held in July at Activities Building 4316. Chris Crumbly, assistant manager of the Science and Mission Systems Office, told employees at the event, "Whatever your job title, you are a space professional contributing to the collective knowledge for the betterment of humankind."

STS-128 *Continued from page 1*

collected and tested through a process called bond adhesion, or "plug pull" testing. The samples were analyzed to validate the bonding characteristics of the foam and to confirm a proper bond between the foam and metal primer underneath. Results indicated good foam bonding.

Foam losses on the intertank are an unusual event because foam has seldom been lost in that area. The intertank is the mechanical connection between the liquid oxygen and liquid hydrogen tanks. It primarily provides structural continuity to the propellant tanks, serves as a protective compartment to house instruments, and receives and distributes thrust loads from the solid rocket boosters.

Nondestructive X-ray evaluations performed on ET-132 ice frost ramps indicated a high confidence level can be expected of the ramps during Discovery's launch.

Shuttle Discovery will deliver the Materials Science Research Rack-1, developed by the Marshall Space Flight Center, to the space station during the mission. About the size of a large refrigerator, it measures 6 feet high, 3.5 feet wide and 40 inches deep and weighs about 1 ton.

The rack will be used for basic materials research in the microgravity environment of the space station. It can accommodate and support diverse experiment modules on material types such as metals, alloys, polymers, semiconductors, ceramics, crystals, and glasses and can be studied to discover new applications for existing materials and new or improved materials.

The research rack will be housed in the U.S. Destiny Laboratory Module and will accommodate the European Space Agency's Materials Science Laboratory – designed to provide controlled materials processing conditions and advanced diagnostics. The development of the rack was a cooperative effort between the Marshall Center and the European Space Agency.

For more information about the STS-128 mission, visit http://www.nasa.gov/mission_pages/shuttle/main/index.html.

For more information about International Space Station science visit http://www.nasa.gov/mission_pages/station/science.

Martel, an AI Signal Research Inc. employee, supports the Office of Strategic Analysis and Communications.

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